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ordinary use, for the axles of the wheels, and forms each axle in two parts, so arranged as to obtain the requisite stiffness, and at the same time to enable either half of the axle, which may become fractured or otherwise made unfit for use, to be readily removed without disturbing the other or uninjured half.

Another important point is the application of very powerful brakes, to check, when required, the action of all the wheels, though the train may be proceeding at full speed. These brakes are adapted to act simultaneously, as well on the rails on which the wheels run, as on the tires of the wheels themselves, and are therefore called compound brakes, and which may be brought into action in three different ways:—

1. By allowing the collision of the carriages to act on the brakes, by an arrangement of rods, cranks, &c., somewhat as in the ordinary buffers.
2. By a windlass under the control of the guard of each carriage.
3. By the addition to each carriage of a small steam cylinder, the piston of which acts on the system of brakes for the four or six wheels. In this case a continuous steam-pipe runs from the boiler of the engine with a branch to each carriage of the train; the connexions of this pipe being formed, by universal joints, to allow of the train passing round curves.

To prevent the carriages running off the rails Mr. Lee proposes to attach to the underframing of each carriage six wooden cheeks, having metal flanches. In the event of the common axles being broken, and even all the wheels removed from the carriage, the latter cannot run off the rails, as the flanches of the cheeks reach to a level sufficiently below the tops of guard-rails fixed along the line, or, in particular parts, between the usual rails of the way. The projector considers this latter plan to be particularly applicable to the crossing of ravines, rivers, embankments, &c.

PROFESSOR FARADAY'S INVENTION FOR THE PERFECT VENTILATION OF LAMP-BURNERS.

By James Faraday.

In consequence of the injury sustained by the books in the library at the Athenæum Club, amounting almost to the entire destruction of the bindings, and the complaints of the members of the vitiated state of the air in the rooms, causing headache, oppressive breathing, and other unpleasant sensations, Professor Faraday's attention, as a member of the club, was drawn to the subject of ventilating lamp-burners in houses, and he was induced to suggest the trial of various plans for effecting the removal of the products of combustion produced by sources of artificial light. All substances used for the purposes of illumination may be represented by oil and coal-gas; although tallow and wax are also employed to a considerable extent, yet as until they are rendered fluid, like oil, they cannot be burnt. Now oil and gas both contain carbon and hydrogen, and it is by the combination of these elements with the oxygen of the air that the light is evolved. The carbon produces carbonic acid, which is deleterious in its nature, and oppressive in its action in closed apartments, and the hydrogen produces water. A pound of oil contains about 0·12 of a pound of hydrogen, 0·78 lb. of carbon, and 0·1 lb. of oxygen; when burnt it produces 1·06 lb. of water, and 2·86 lb. of carbonic acid; and the oxygen it takes from the atmosphere is equal to that contained in 13·27 cubic feet of air. A pound of London coal-gas contains, on an average, 0·3 lb. of hydrogen, and 0·7 lb. of carbon; produces when burnt 2·7 lbs. of water, and 2·56 lbs. of carbonic acid gas; consumes 4·26 cubic feet of oxygen, equal to the quantity contained in 19·3 cubic feet of air. So a pint of oil when burnt produces 1¼ pint of water, and a pound of gas produces above 2½ pints of water; the increase of weight being due to the absorption of oxygen from the atmosphere, 1 part of hydrogen taking 8 by weight of oxygen to form water. A London Argand gas-lamp, in a close shop-window, will produce in four hours 2½ pints of water, to condense or not, according to circumstances, upon the glass or the goods, as it may happen. Also a pound of oil produces nearly 3 lbs. of carbonic acid, and a pound of gas 2½ lbs. of carbonic acid. Now carbonic acid is a poison, an atmosphere containing even $\frac{1}{10}$th of it is soon fatal to animal life.

Mr. Leblanc has recently analysed carefully the confined air of inhabited places, and concludes, as stated in his memoir, that the proportion of carbonic acid gas in such places may be regarded as measuring with sufficient exactness the insalubrity of the air; that in the proportion of 1 part to 100 of air, ventilation is indispensable for the prevention of injury to the health; that the proportion of carbonic acid gas had better not exceed a 500th part, though it may rise without inconvenience to a 200th part. If a lighted taper be applied to the top of a lamp chimney it will be instantly extinguished, or a glass jar held over it will become immediately filled with air in which a light cannot burn. Also sulphurous and sulphuric acid are contained in the water which results from the combustion of coal-gas, and are products injurious to metals and articles of furniture.

The object sought to be obtained in the ventilation of lamp-burners is the entire removal of all the noxious products of combustion, and with this view, at Professor Faraday's suggestion, the gas-lights of the chandelier in the library at the Athenæum were ventilated by pipes dipping into the lamp-glasses and conjoining, at a short distance upwards, into one central pipe, which carried away all the burnt air from the room. In this first practical experiment many things were learned as to the mode of arranging the pipes, the disposal, when the pipes were very long, of the water produced, &c. &c.; but the objects sought for by the ventilation were at once and perfectly obtained.

Next arose the desire of modifying the system by removing the ascending flue from its place over the lamp, not from any deficiency in action, but for appearance sake only; and finding there was sufficient ascension power in the main part of the metal chimney to allow of a descending draught over the lamp, the tube, in place of going directly upwards, was made to turn short over the edge of the glass, to descend to the arm or bracket, to pass along it, and then ascend at the central part of the chandelier, or against the wall, if applied to a single light. The gas-light has its chimney as usual, but the glass-holder is so constructed as to sustain not merely the chimney but an outer cylinder of glass, larger and taller than the first, and closed at the top by a plate of mica, or, still better, by two plates of mica, one resting on the top of the glass and the other dropping a short way into it, and connected together with a metal screw and nut, which also keeps them a little apart from each other; thus forming a stopper which cannot be shaken off, but is easily lifted on and off by a small metal ring or knob at the top. The glass-holder has an aperture in it connected by a mouth-piece with a metal tube, which serves as a ventilating flue, and which, after passing horizontally to the centre of the chandelier, thence ascends to produce draught and carry off the burnt air. Now, with a lamp burning in the ordinary way, the products of combustion issue out as a torrent of aërial impurity from above; but if the above arrangement be applied on closing the top of the outer glass cylinder by the plate of mica, all the soot, water, carbonic acid, sulphurous and sulphuric acid, and a portion of the heat, are entirely carried away and discharged into a chimney or the open air; and the air in rooms may thus be kept in the same wholesome condition and as fit for the purposes of respiration as if artificial light were not being used.

A curious but important result of the enclosed lamp is the increase of light produced, amounting to from ten to twenty per cent, according to circumstances, the same quantity of gas being consumed as before. If the current of air through a lamp-glass, when the gas is burning in the usual manner, be diminished, the flame rises in height and the light is increased in amount, but is of a redder colour: the combustion, in fact, is not so intense, because the access of air is retarded, the particles of carbon which give the light are not so highly ignited, but are more abundant, and are ignited for *a longer time*, thereby causing an increase of light.

STEPHEN'S LIFE-PRESERVER, OR PORTABLE LIFE-BALL AND LINE.

This apparatus consists of a hollow metal ball, about five inches in diameter, to which are brazed or riveted three eyes, and a line fixed, of about twenty fathoms or upwards in length, of half-inch Hambro' layed rope, having a sliding thimble to form the noose. In order to prevent its being damaged, it is quilted over with net-work, similar to a child's ball, being, however, first cased with cork, so as to render it more buoyant. Through one of the eyes is rove the line which passes round the ball, and is again brought through the eye in the opposite direction; both parts are then seized together outside the eye, leaving sufficient line, with a thimble in the end, to form a bight. The standing part of the line is then passed through the thimble, and a noose formed sufficiently large to admit of it passing over a person's shoulders, to fasten round his waist. The other two eyes are placed opposite to each other, through which a piece of line is rove round the ball, and seized in four places, so as to form grummetts or handles to the "life-ball," in order that it may be the more readily held or caught hold of.

The life-ball, from its portability, can be carried to any part of the vessel, and thrown in the direction of the person overboard; whereas the life-buoy, when put in operation on a casualty occurring, although it may be immediately let go and dropped, yet from its nature will remain stationary in the wake of the ship, and unless the person be a good swimmer it is almost impossible he can reach it, particularly should he happen to fall overboard to leeward, a circumstance which more frequently happens than otherwise.

MR. DEFRIES' DRY GAS-METER.

The description of this ingenious machine will be facilitated by comparing it with the double-acting steam-engine, with which it is closely analogous, although the corresponding parts move with so little friction, that the trifling pressure of one or two pounds per square inch, thrown on the gas in the mains, is sufficient to move